WHAT IS CLAIMED IS:

1. A process of growing a thin film of Al_2O_3 on a substrate by a sequential vapor deposition process comprising a plurality of cycles, each cycle comprising:

exposing the part to gaseous trimethyl aluminum (TMA);

stopping provision of the gaseous TMA;

removing gaseous TMA from the chamber;

exposing the part to atomic oxygen; and

removing atomic oxygen from the chamber,

wherein in each cycle more than one monolayer of Al_2O_3 is formed.

2. The process of claim 1, wherein in each cycle a layer of Al_2O_3 3 Å thick is formed.

3. The process of Claim 1, wherein the oxygen radicals are generated remotely in a radical generator.

4. The process of Claim 1, wherein the process is carried out at room temperature.

5. A method of joining two parts comprising:

growing aluminum oxide on the two parts by a sequential vapor deposition process comprising:

exposing the parts to gaseous first reactant comprising aluminum, wherein at least a portion of the first reactant adsorbs on the part in a self-limiting process;

removing substantially all of the gaseous first reactant from the chamber;

exposing the parts to a gaseous second reactant of radicals, wherein the radicals convert the first reactant on the part to aluminum; and

oxidizing the aluminum to form aluminum oxide.

6. The method of Claim 5, wherein the gaseous first reactant is trimethyl aluminum.

7. The method of Claim 5, wherein the gaseous second reactant of radicals comprises hydrogen atoms.

8. The method of Claim 5, wherein the aluminum oxide is grown on the parts at room temperature.

9. The method of Claim 5, wherein the parts are adjacent to each other and the aluminum oxide is grown on each part simultaneously in the same reaction chamber.

10. A method of coating a fiber comprising:

growing aluminum oxide on the fiber by a sequential vapor deposition process comprising:

exposing the fiber to a gaseous first reactant comprising aluminum, wherein at least a portion of the first reactant adsorbs on the fiber in a self-limiting process;

converting the portion of the first reactant adsorbed on the fiber to aluminum or aluminum oxide by exposing the fiber to a gaseous second reactant that includes radicals.

11. The method of Claim 10, wherein the fiber is a carbon fiber.

12. The method of Claim 11, further comprising growing silicon carbide on the fiber prior to growing aluminum oxide.

13. The method of Claim 10, wherein the gaseous second reactant comprises atomic oxygen and the portion of the first reactant adsorbed on the fiber is converted to aluminum oxide.

14. The method of Claim 10, wherein the gaseous second reactant comprises atomic hydrogen and the portion of the first reactant adsorbed on the fiber is converted to aluminum.

15. The method of Claim 14, additionally comprising oxidizing the aluminum to form aluminum oxide.

16. The method of Claim 10, wherein the sequential chemical vapor deposition process is conducted at room temperature.

17. A method of forming an oxynitride on a part in a reaction chamber by a sequential chemical vapor deposition process comprising:

exposing the part to a stable first reactant, including an element of the oxynitride to be formed, wherein at least a portion of the first reactant adsorbs on the part;

evacuating the chamber of gases;

exposing the part, coated with the first reactant to a gaseous second reactant, wherein the gaseous second reactant coverts some of the first reactant to a first compound;

evacuating the chamber of gases; and

exposing the part to a gaseous third reactant,

wherein at least one of the second and third reactants comprises a radical.